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Mapping Concentration and Spatial Distribution of Cyanobacteria in Mesotrophic to Eutrophic Reservoirs Using Airborne Hyperspectral Remote Sensing Imagery

Sengpiel, R.[1], Li, L. [1], Tedesco, L.P. [1], Wilson, J. [2], Pascual, D.L. [1], and Moran, D. [3]

[1] IUPUI Department of Earth Sciences
[2] IUPUI Department of Geography
[3] Veolia Water Indianapolis, LLC.

Cyanobacteria blooms contribute to the degradation of reservoirs by causing aesthetic problems, such as surface scum and unpleasant odors, changes in the taste of treated drinking water and potential toxicity. Monitoring of Cyanobacteria blooms and the conditions that foster bloom formation via *in-situ* water sampling is both time and labor intensive, and often limited to infrequent collections at a small number of stations within a reservoir. While Cyanobacteria blooms in Indianapolis's three drinking water reservoirs have been investigated intensively, water resource managers lack a tool capable of providing information about the spatial distribution and composition of blooms. Remote sensing techniques may provide a faster, more efficient method for mapping these Cyanobacteria blooms.

The primary objective of this research is to develop a more efficient survey tool which uses remotely sensed spectra as a proxy for *in situ* water quality data to allow for more rapid determination of Cyanobacteria concentration and spatial distribution in drinking water reservoirs. The approach utilizes the spectral characteristics of Chlorophyll *a* and Phycocyanin as captured by the Airborne Imaging Spectrometer for Applications (AISA) sensor. Water quality samples were collected in Indianapolis's three drinking water reservoirs (Geist, Morse, and Eagle Creek) on September 6, 2005 at approximately 30 sites on each reservoir concurrent with the imagery acquisition. Samples were analyzed for Chlorophyll *a*, Phycocyanin, total suspended solids, and other water quality constituents. Airborne spectra were collected with the AISA sensor by the University of Nebraska Lincoln's CALMIT laboratory. The image data have a spectral range of approximately 400 nm to 800 nm with 8.75nm – 9.61 nm bandwidth resolution which provide 5 million reflectance spectra for each reservoir at a spatial resolution of 1 m^2. After correcting for geometric distortion and spectral attenuation, spectral data from a subset of locations, that match GPS coordinates of ground truth samples, were retrieved to create a calibration data set. With reference to results from relating field spectra to Cyanobacterial blooms, an algorithm was applied to link the airborne spectra in the calibration set to Chlorophyll *a* concentration. The algorithm was then applied to the entire AISA image to generate a map of Chlorophyll *a* distribution for Geist reservoir (Marion County, Indiana). Preliminary results from this Reservoir indicate the development of a successful survey tool is dependent upon appropriate image processing techniques to account for the interfering factors that effect spectral reflectance. After being refined and finalized, this same technique will be used to develop additional Chlorophyll *a* maps and algorithms for the two other reservoirs.

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